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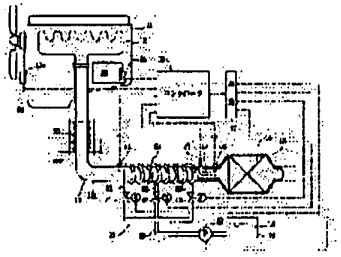
(71)Applicant : HINO MOTORS LTD
(72)Inventor : MOGI HIRONOBU
TOMONO YASUYUKI
HOSOYA MITSURU

(54) REDUCING DEVICE OF NOX IN ENGINE EXHAUST GAS

(57)Abstract:
PURPOSE: To reliably reduce NOx by gasifying a reducing agent even if an exhaust gas temperature is a low temperature without lowering a surface temperature of an NOx catalyst and without increasing flow speed of exhaust gas.
CONSTITUTION: An injection nozzle 17 is arranged in an upstream side exhaust pipe 13a on the more upstream side of exhaust gas than an NOx catalyst 14 arranged in an exhaust pipe 13 of an engine 11, and a pump 22 forcibly sends a reducing agent 18 stored in a tank 19 to the injection nozzle through a supply pipe 21. The base end of a main pipe line 23 of the supply pipe is connected to a delivery port of the pump, and the injection nozzle is connected to the downstream end of a heating pipe line 24 wound round an outer peripheral surface of the upstream side exhaust pipe. The tips of plural branch pipe lines 31 to 33 whose base ends are connected to the tip of the main pipe line are respectively connected to the heating pipe line by changing a length in which the reducing agent passes through the heating pipe line. A controller 36 controls valves 41 to 43 to respectively open and close the plural branch pipes on the basis of respective detecting outputs of temperature sensors 51 and 52 to detect an exhaust gas temperature and a reducing agent temperature sensor 27 to detect a temperature of the reducing agent.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The NOx catalyst prepared in the exhaust pipe (13) connected to the engine (11) through the exhaust manifold (12) (14), The injection section prepared in the upstream exhaust pipe (13a) of the exhaust gas upstream from said NOx catalyst (14) (17), The pump which feeds the tank (19) in which a hydrocarbon system reducing agent (18) is stored, and the reducing agent (18) stored in said tank (19) in said injection section (17) through a supply pipe (21) (22), In the NOx reduction equipment in engine exhaust gas equipped with the bulb (41-43) which is prepared in said supply pipe (21), and opens and closes said supply pipe (21) The main line where the end face was connected to the delivery of said pump (22) for said supply pipe (21) (23), The heating duct where it was wound around the peripheral face of said upstream exhaust pipe (13a), and said injection section (17) was connected to the down-stream edge (24), It has two or more branched pipes (31-33) which changed the die length to which a end face is connected at the tip of said main line (23), and a tip passes through the heating duct (24) of said reducing agent (18), and were connected to said heating duct (24), respectively. It is constituted so that said bulb (41-43) may open any 1 or two branched pipes or more (31-33) in said two or more branched pipes (31-33). The temperature sensor (51 52) which detects the exhaust gas temperature in said upstream exhaust pipe (13a) or said exhaust manifold (12) is inserted in said upstream exhaust pipe (13a) or said exhaust manifold (12). The reducing-agent temperature sensor (27) which detects the temperature of the reducing agent (18) before being injected from said injection section (17) is inserted in said heating duct (24) or said injection section (17). NOx reduction equipment in the engine exhaust gas characterized by being constituted so that a controller (36) may control said bulb (41-43) based on each detection output of said temperature sensor (51 52) and said reducing-agent temperature sensor (27).
[Claim 2] The NOx catalyst prepared in the exhaust pipe (13) connected to the engine (11) through the exhaust manifold (12) (14), The injection section prepared in the upstream exhaust pipe (13a) of the exhaust gas upstream from said NOx catalyst (14) (67), The pump which feeds the tank (19) in which a hydrocarbon system reducing agent (18) is stored, and the reducing agent (18) stored in said tank (19) in said injection section (67) through a supply pipe (61) (22), In the NOx reduction equipment in engine exhaust gas equipped with the bulb (41-43) which is prepared in said supply pipe (61), and opens and closes said supply pipe (61) The main line where the end face was connected to the delivery of said pump (22) for said supply pipe (61) (23), The heating duct where it was inserted in said upstream exhaust pipe (13a) along with the longitudinal direction of this exhaust pipe (13a), and said injection section (67) was connected to the down-stream edge (64), It has two or more branched pipes (71-73) inserted so that a end face might be connected at the tip of said main line (23), and a tip might be connected to the upper edge of said heating duct (64) and overall lengths might differ in said exhaust manifold (12), respectively. It is constituted so that said bulb (41-43) may open any 1 or two branched pipes or more (71-73) in said two or more branched pipes (71-73). The reducing-agent temperature sensor (27) which detects the temperature of the reducing agent (18) before being injected from said injection section (67) is inserted in said heating duct (64) or said injection section (67). NOx reduction equipment in the engine exhaust gas characterized by being constituted so that a

controller (36) may control said bulb (41-43) based on the detection output of said reducing-agent temperature sensor (27).
[Claim 3] The NOx catalyst prepared in the exhaust pipe (13) connected to the engine (11) through the exhaust manifold (12) (14), The injection nozzle prepared in the upstream exhaust pipe (13a) of the exhaust gas upstream from said NOx catalyst (14) (81-83), The pump which feeds the tank (19) in which a hydrocarbon system reducing agent (18) is stored, and the reducing agent (18) stored in said tank (19) to said injection nozzle (81-83) through a supply pipe (111) (22), In the NOx reduction equipment in engine exhaust gas equipped with the bulb (41-43) which is prepared in said supply pipe (111), and opens and closes said supply pipe (111) The main line where said injection nozzle (81-83) changed the distance from said NOx catalyst (14) into said upstream exhaust pipe (13a), and were prepared, and the end face was connected to the delivery of said pump (22) for said supply pipe (111) (23), [two or more] It has two or more branched pipes (91-93) by which the end face was connected to said main line (23), and said two or more injection nozzles (81-83) were connected at the tip, respectively. It is constituted so that said bulb (41-43) may open any 1 or two branched pipes or more (91-93) in said two or more branched pipes (91-93). The temperature sensor (101-104) which detects the exhaust gas temperature in said upstream exhaust pipe (13a) or said exhaust manifold (12) is inserted in said upstream exhaust pipe (13a) or said exhaust manifold (12). NOx reduction equipment in the engine exhaust gas characterized by being constituted so that a controller (36) may control said bulb (41-43) based on the detection output of said temperature sensor (101-104).

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the equipment which reduces the nitrogen oxides (henceforth NOx) contained in engine exhaust gas according to a catalyst. Furthermore, it is related with the NOx reduction equipment in the exhaust gas of the engine for cars in detail.
[0002]
[Description of the Prior Art] Patent application of the exhaust gas purge constituted so that the catalytic converter with which, as for these people, the NOx catalyst and the oxidation catalyst were held in the middle of the engine exhaust pipe as NOx [the former and this kind of] reduction equipment might be connected, an injection nozzle might be prepared in the upstream exhaust pipe of the exhaust gas upstream from a catalytic converter, a hydrocarbon system reducing agent might be stored in a tank and a pump might feed the above-mentioned reducing agent to an injection nozzle through a supply pipe was carried out (JP,4-276113,A). Thus, in the constituted exhaust gas purge, the exhaust gas which flows an upstream exhaust pipe is supplied, and a reducing agent is evaporated within an exhaust pipe, serves as reducibility gas, and is supplied to an NOx catalyst and an oxidation catalyst with exhaust gas. Consequently, NOx can be reduced at the high effectiveness included in exhaust gas in an NOx catalyst by reducibility gas, and the carbon monoxide further generated in the case of an excessive hydrocarbon and the above-mentioned reduction can be oxidized now in an oxidation catalyst.
[0003]
[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional exhaust gas purge, since a low-temperature reducing agent was injected from an injection nozzle and supplied to an NOx catalyst compared with ordinary temperature, i.e., exhaust gas, there was a possibility that a reducing agent might take heat of vaporization from exhaust gas or a catalyst front face, the temperature on the front face of a catalyst might fall, and the catalyst engine performance might fall. Moreover, in the above-mentioned conventional exhaust gas purge, from an injection nozzle, since it was made the shape of Myst by the compression air for injection and a reducing agent was injected, when the rate of flow of exhaust gas increased, ratio contact on exhaust gas and the front face of a catalyst of a reducing agent decreased, and there was a case where the catalyst engine performance fell. Furthermore, in the above-mentioned conventional exhaust gas purge, when the exhaust gas temperature at the time of engine starting etc. was low, there was a trouble with it difficult [for a reducing agent not to evaporate, but to supply a catalyst, while it has been Myst-like, and to supply a reducing agent to homogeneity at a catalyst].
[0004] The purpose of this invention is to offer [to change a reducing agent into the condition near evaporation or evaporation, even if exhaust gas temperature is low temperature comparatively, and] the NOx reduction equipment in the engine exhaust gas which can reduce NOx certainly, without not reducing NOx catalyst skin temperature and increasing the rate of flow of exhaust gas.
[0005]
[Means for Solving the Problem] The configuration of this invention for attaining the above-

mentioned purpose is explained using drawing 1 corresponding to an example - drawing 3 . The NOx catalyst 14 prepared in the exhaust pipe 13 connected to the engine 11 through the exhaust manifold 12 as the 1st was shown in drawing 1 of this invention, The injection section 17 prepared in upstream exhaust pipe 13a of the exhaust gas upstream from the NOx catalyst 14, It is amelioration of the NOx reduction equipment in engine exhaust gas equipped with the tank 19 in which the hydrocarbon system reducing agent 18 is stored, the pump 22 which feeds the reducing agent 18 stored in the tank 19 in the injection section 17 through a supply pipe 21, and the bulbs 41-43 which are prepared in a supply pipe 21, and open and close a supply pipe 21. The main line 23 where, as for the characteristic configuration, the end face was connected to the delivery of a pump 22 for the supply pipe 21, The heating duct 24 where it was wound around the peripheral face of upstream exhaust pipe 13a, and the injection section 17 was connected to the down-stream edge, It has two or more branched pipes 31-33 which changed the die length to which a end face is connected at the tip of a main line 23, and a tip passes through the heating duct 24 of a reducing agent 18, and were connected to the heating duct 24, respectively. It is constituted so that bulbs 41-43 may open any 1 or two branched pipes 31-33 or more among two or more branched pipes 31-33. The temperature sensors 51 and 52 which detect the exhaust gas temperature in upstream exhaust pipe 13a are inserted in upstream exhaust pipe 13a. The reducing-agent temperature sensor 27 which detects the temperature of the reducing agent 18 before being injected from the injection section 17 is inserted in the heating duct 24, and it is in the place constituted so that a controller 36 might control bulbs 41-43 based on each detection output of temperature sensors 51 and 52 and the reducing-agent temperature sensor 27.
[0006] The main line 23 where the end face was connected to the delivery of a pump 22 for the supply pipe 61 as the 2nd was shown in drawing 2 of this invention, The heating duct 64 where it was inserted in upstream exhaust pipe 13a along with the longitudinal direction of this exhaust pipe 13a, and the injection section 67 was connected to the down-stream edge, It has two or more branched pipes 71-73 inserted so that a end face might be connected at the tip of a main line 23, and a tip might be connected to the upper edge of the heating duct 64 and overall lengths might differ in an exhaust manifold 12, respectively. It is constituted so that bulbs 41-43 may open any 1 or two branched pipes 71-73 or more among two or more branched pipes 71-73. The reducing-agent temperature sensor 27 which detects the temperature of the reducing agent 18 before being injected from the injection section 67 is inserted in the heating duct 64, and it is characterized by being constituted so that a controller 36 may control bulbs 41-43 based on the detection output of the reducing-agent temperature sensor 27.
[0007] The main line 23 where injection nozzles 81-83 changed the distance from the NOx catalyst 14 into upstream exhaust pipe 13a, and were prepared in as the 3rd was shown in drawing 3 of this invention, and the end face was connected to the delivery of a pump 22 for the supply pipe 111, [two or more] It has two or more branched pipes 91-93 by which the end face was connected to the main line 23, and two or more injection nozzles 81-83 were connected at the tip, respectively. It is constituted so that bulbs 41-43 may open any 1 or two branched pipes 91-93 or more among two or more branched pipes 91-93. The temperature sensors 101-104 which detect the exhaust gas temperature in upstream exhaust pipe 13a or an exhaust manifold 12 are inserted in upstream exhaust pipe 13a or an exhaust manifold 12. It is characterized by being constituted so that a controller 36 may control bulbs 41-43 based on the detection output of temperature sensors 101-104.
[0008]
[Function] With the NOx reduction equipment shown in drawing 1 , a controller 36 changes the distance in which a reducing agent 18 passes through the heating duct 24 by choosing the branched pipes 31-33 which pass a reducing agent 18 according to change of the exhaust gas temperature in upstream exhaust pipe 13a. Consequently, since it is maintained at abbreviation regularity and a reducing agent 18 will be in the condition near evaporation or evaporation, and the temperature of the reducing agent 18 injected from the injection section 17 decomposes suitably and becomes high activity more, a reducing agent 18 is supplied to the NOx catalyst 14 at homogeneity, and NOx can be reduced certainly. With the NOx reduction equipment shown in

drawing 2 , a controller 36 changes the distance in which a reducing agent 18 passes the branched pipes 71-73 in an exhaust manifold 12 by choosing the branched pipes 71-73 which pass a reducing agent 18 according to change of the temperature of the reducing agent 18 in the heating duct 64. With the NOx reduction equipment shown in drawing 3 , a controller 36 changes the distance in which a reducing agent 18 passes upstream exhaust pipe 13a by choosing the branched pipes 91-93 which pass a reducing agent 18 according to change of the exhaust gas temperature in upstream exhaust pipe 13a.

[0009]

[Example] Next, the 1st example of this invention is explained in detail based on a drawing. As shown in drawing 1 , an exhaust pipe 13 is connected to a diesel power plant 11 through an exhaust manifold 12. The catalytic converter 16 with which the NOx catalyst 14 was held in the middle of this exhaust pipe 13 is formed. In this example, the NOx catalyst 14 is a monolithic catalyst and coating of the metallosilicate catalyst which supported a copper ion exchange zeolite (Cu-ZSM -5) catalyst or copper to the honeycomb simple substance of cordierite nature is carried out. The injection nozzle 17 which can inject the hydrocarbon system reducing agent 18 to upstream exhaust pipe 13a of the exhaust gas upstream is formed in about 16 catalytic converter towards the NOx catalyst 14 from the NOx catalyst 14. The above-mentioned reducing agent 18 is stored in a tank 19, and is fed by the nozzle 17 with a pump 22 through a supply pipe 21. A reducing agent 18 is gas oil in this example.

[0010] A supply pipe 21 is equipped with the main line 23 where the end face was connected to the delivery of a pump 22, the heating duct 24 where it was wound around the peripheral face of upstream exhaust pipe 13a, and the nozzle 17 was connected to the down-stream edge, and two or more branched pipes 31-33 which changed the die length to which a tip passes through the heating duct 24 of a reducing agent 18 by connecting a end face at the tip of a main line 23, and were connected to the heating duct 24, respectively. In this example, the heating duct 24 is twisted among upstream exhaust pipe 13a more nearly spirally [a predetermined distance / the upstream] than a nozzle 17, and, as for branched pipes 31-33, the 1st - the 3rd three branched pipes 31-33 are formed. The tip of the 1st branched pipe 31 is connected to the upper edge of the heating duct 24, the tip of the 2nd branched pipe 32 is connected in the center of abbreviation of the heating duct 24, and the tip of the 3rd branched pipe 33 is connected near the down-stream edge of the heating duct 24. The 1st which opens and closes these branched pipes 31-33, respectively - the 3rd closing motion valves 41-43 are formed in the 1st - the 3rd branched pipe 31-33, and an electric heater 26 is twisted around the peripheral face of upstream exhaust pipe 13a so that it may be located between an exhaust manifold 12 and the heating duct 24. In this example, the closing motion valves 41-43 are solenoid valves which open and close branched pipes 31-33, respectively, and if they are turned on, and branched pipes 31-33 are opened, respectively and they turn them off, they will close branched pipes 31-33, respectively.

[0011] Moreover, the temperature sensors 51 and 52 which detect the temperature of the exhaust gas which flows the inside of this exhaust pipe 13a are inserted in upstream exhaust pipe 13a. Temperature sensors 51 and 52 are two of the 1st and 2nd temperature sensors 51 and 52 in this example. The 2nd temperature sensor 52 is inserted in the upstream for the 1st temperature sensor 51 between a nozzle 17 and the NOx catalyst 14 from the heating duct 24, respectively. 27 is the reducing-agent temperature sensor inserted in the down-stream edge of the heating duct 24, and the temperature of the reducing agent 18 which changed into the condition near evaporation or evaporation just before being injected from a nozzle 17 by this sensor 27 is detected. Moreover, the rotation sensor 28 which detects the rotational speed of this crankshaft 11a is formed in crankshaft 11a of an engine 11, and the load sensor 34 which detects the location of a control rack (not shown) is formed in a fuel injection pump 29. It connects with the control input of a controller 36, and the detection output of the 1st temperature sensor 51, the 2nd temperature sensor 52, the reducing-agent temperature sensor 27, the rotation sensor 28, and the load sensor 34 is connected to the control output of a controller 36 through the drive circuit 37 at a pump 22, the 1st - the 3rd closing motion valves 41-43, and an electric heater 26. Moreover, although the delivery and tank 19 of a pump 22 are not illustrated, when the return pipe which has a check valve connects and all the 1st - 3rd

closing motion valves 41-43 close, the reducing agent 18 breathed out with the pump 22 is returned to a tank 19.

[0012] Thus, actuation of the NOx reduction equipment in the constituted engine exhaust gas is explained. Since the exhaust gas temperature which an engine 11 is a light load first, and is discharged from an engine 11 and detected by the 1st temperature sensor 51 at the time of the operational status of a low-speed area is less than 300 degrees C, a controller 36 turns on the 1st closing motion valve 41, and opens the 1st branched pipe 31. The reducing agent 18 fed with the pump 22 flows into the heating duct 24 from the upper edge through the 1st branched pipe 31, and flows toward the down-stream edge of the heating duct 24. Even if the peripheral face temperature of upstream exhaust pipe 13a is comparatively low at this time, the distance in which a reducing agent 18 passes through the heating duct 24 is long, and since that heating time is long, a reducing agent 18 is fully heated and it becomes easy to evaporate it. The reducing agent 18 which was heated by upstream exhaust pipe 13a and changed into the condition near evaporation or evaporation is injected toward the NOx catalyst 14 by the pressure build-up accompanying the above-mentioned evaporation from an injection nozzle 17. Moreover, since a reducing agent 18 is ignited in the state of anoxia in the heating duct 24 at this time, a reducing agent 18 decomposes suitably and becomes high activity more. Consequently, since NOx catalyst 14 skin temperature is not reduced with a reducing agent 18 and a reducing agent 18 is supplied to the NOx catalyst 14 at homogeneity, the engine performance of the NOx catalyst 14 can fully be pulled out, and NOx can be reduced certainly.

[0013] If the exhaust gas temperature which the 1st temperature sensor 51 detects becomes 300 degrees C or more and the reducing-agent temperature sensor 27 detects reducing-agent 18 temperature of 300 degrees C or more, a controller 36 turns off the 1st closing motion valve 41, and turns on the 2nd closing motion valve 42. Since a reducing agent 18 serves as the abbreviation half of the above [the distance which passes through the heating duct 24] and the heating time becomes short, the temperature of a reducing agent 18 becomes less than 300 degrees C, and a reducing agent 18 burns or it does not oxidize. If the exhaust gas temperature which the 1st temperature sensor 51 detects becomes still higher and becomes 400 degrees C or more, a controller 36 turns off the 2nd closing motion valve 42, and turns on the 3rd closing motion valve 43. Although the distance which passes through the heating duct 24 has a very short reducing agent 18, since the temperature of upstream exhaust pipe 13a is high, a reducing agent 18 is evaporated immediately. Moreover, like [at the time of starting of a chill term], when exhaust gas temperature is very low, a controller 36 operates an electric heater 26, and when the reducing-agent temperature sensor 27 detects that the temperature of the reducing agent 18 in the down-stream edge of the heating duct 24 amounted to 300 degrees C, an electric heater 26 is stopped.

[0014] Drawing 2 shows the 2nd example of this invention. In drawing 2 , the same sign as drawing 1 shows the same components. In this example, the heating duct 64 of a supply pipe 61 is inserted in upstream exhaust pipe 13a along with the longitudinal direction of this exhaust pipe 13a, and two or more branched pipes 71-73 are inserted in an exhaust manifold 12 so that overall lengths may differ, respectively. An injection nozzle 67 is connected to the down-stream edge of the heating duct 64. In this example, the number of two or more branched pipes 71-73 is three, and toward the front end, the 1st - the 3rd branched pipe 71-73 open predetermined spacing in order, and they are inserted from the back end of an exhaust manifold 12. The end face of these branched pipes 71-73 is connected at the tip of a main line 23, and the tip of branched pipes 71-73 is connected to the upper edge of the heating duct 64. The tip of the 3rd branched pipe 73 is in the condition which bent the upper edge of the heating duct 64 and was made to counter at the tip of the 3rd branched pipe 73, and is connected to the upper edge of the heating duct 64. The tip of the 2nd branched pipe 72 is bent and it connects with the connection at the upper edge of the heating duct 64, and the tip of the 3rd branched pipe 73, and the tip of the 1st branched pipe 71 is bent and is connected to the bending section of the 2nd branched pipe 72. The case where the 1st branched pipe 71 is passed is the longest, and then is the 2nd branched pipe 72, and the die length of each branched pipes 71-73 which a reducing agent 18 passes within an exhaust manifold 12 is constituted so that the case where

the 3rd branched pipe 73 is passed may become the shortest.
[0015] Moreover, the 1st which opens and closes these branched pipes 71-73 - the 3rd closing motion valves 41-43 are formed in the part which projects from an exhaust manifold 12 among the 1st - the 3rd branched pipe 71-73, respectively, and the reducing-agent temperature sensor 27 which detects the temperature of the reducing agent 18 in the heating duct 64 is inserted in the heating duct 64. A controller 36 is constituted so that the 1st - the 3rd closing motion valves 41-43 may be controlled based on each detection output of the reducing-agent temperature sensor 27, the rotation sensor 28, and the load sensor 34.
[0016] thus, in actuation of the constituted NOx reduction equipment By choosing the branched pipes 71-73 which pass a reducing agent 18 according to change of the temperature of the reducing agent 18 in the heating duct 64, a controller 36 The distance in which a reducing agent 18 passes the branched pipes 71-73 in an exhaust manifold 12 is changed. Except for being heated when a reducing agent 18 passes through the branched pipes 71-73 in an exhaust manifold 12, and the heating duct 64 in upstream exhaust pipe 13a, since it is the same as that of actuation of the 1st example of the above, explanation of a repetition is omitted.
[0017] Drawing 3 shows the 3rd example of this invention. In drawing 3 , the same sign as drawing 1 shows the same components. In this example, injection nozzles 81-83 change the distance from the NOx catalyst 14 into upstream exhaust pipe 13a, and are prepared, and two or more injection nozzles 81-83 are connected at the tip of two or more branched pipes 91-93 of the supply pipe 111 by which the end face was connected to the main line 23, respectively. [two or more] In this example, the 1st - the 3rd three injection nozzles 81-83 are formed, and, as for injection nozzles 81-83, the 1st - the 3rd three branched pipes 91-93 are formed, as for branched pipes 91-93. The 1st injection nozzle 81 is inserted near the upper edge of upstream exhaust pipe 13a, the 2nd injection nozzle 82 is inserted in the center of abbreviation of the longitudinal direction of upstream exhaust pipe 13a, and the 3rd injection nozzle 83 is inserted near the down-stream edge of upstream exhaust pipe 13a. The tip of the 1st - the 3rd branched pipe 91-93 is connected to the 1st - the 3rd injection nozzle 81-83, respectively. The 1st which opens and closes these branched pipes 91-93 - the 3rd closing motion valves 41-43 are formed in the 1st - the 3rd branched pipe 91-93, respectively. Between the 2nd and 3rd injection nozzles 82 and 83, electric heaters 84 and 86 are twisted between the 1st and 2nd injection nozzles 81 and 82 among upstream exhaust pipe 13a, respectively.
[0018] The 1st temperature sensor 101 which detects the exhaust gas temperature which passes this part is inserted in the down-stream edge of an exhaust manifold 12, the 2nd temperature sensor 102 which detects the exhaust gas temperature which passes this part is inserted in the center of abbreviation of the longitudinal direction of upstream exhaust pipe 13a, and the 3rd temperature sensor 103 which detects the exhaust gas temperature which passes this part is inserted in the down-stream edge of upstream exhaust pipe 13a. Moreover, the 4th temperature sensor 104 which measures the exhaust gas temperature which passes this part is inserted in downstream exhaust pipe 13b of the exhaust gas downstream from the NOx catalyst 14. It connects with the control input of a controller 36, and each detection output of the 1st - the 4th temperature sensor 101-104, the rotation sensor 28, and the load sensor 34 is connected to the control output of a controller 36 through the drive circuit 37 at the 1st - the 3rd closing motion valves 41-43, a pump 22, and electric heaters 84 and 86.
[0019] Thus, actuation of the NOx reduction equipment in the constituted engine exhaust gas is explained. Since the exhaust gas temperature which an engine 11 is a light load first, and is discharged from an engine 11 and detected by the 1st temperature sensor 101 at the time of the operational status of a low-speed area is less than 300 degrees C, a controller 36 turns on the 1st closing motion valve 41, and opens the 1st branched pipe 91. The reducing agent 18 fed with the pump 22 is injected from the 1st injection nozzle 81 through the 1st branched pipe 91. The distance in which a reducing agent 18 passes upstream exhaust pipe 13a although the exhaust gas temperature which is Myst-like since the temperature of this injected reducing agent 18 is low and it is close to ordinary temperature, and passes through the inside of upstream exhaust pipe 13a is also comparatively low is long, since that heating time is long, a reducing agent 18 is fully heated, and it will be in the condition near evaporation or evaporation, it decomposes still

more suitably, and becomes high activity more. Consequently, since NOx catalyst 14 skin temperature is not reduced with a reducing agent 18 and a reducing agent 18 is supplied to the NOx catalyst 14 at homogeneity, the engine performance of the NOx catalyst 14 can fully be pulled out, and NOx can be reduced certainly.
[0020] If the exhaust gas temperature which the 1st temperature sensor 101 detects becomes 300 degrees C or more, a controller 36 turns off the 1st closing motion valve 41, and turns on the 2nd closing motion valve 42. Since a reducing agent 18 serves as the abbreviation half of the above [the distance which passes upstream exhaust pipe 13a] and the heating time becomes short, the temperature of a reducing agent 18 becomes less than 300 degrees C, and a reducing agent 18 burns or it does not oxidize. If the exhaust gas temperature which the 1st temperature sensor 101 detects becomes still higher and becomes 400 degrees C or more, a controller 36 turns off the 2nd closing motion valve 42, and turns on the 3rd closing motion valve 43. Although the distance which passes upstream exhaust pipe 13a has a very short reducing agent 18, since the exhaust gas temperature in upstream exhaust pipe 13a is high, a reducing agent 18 is evaporated immediately. Moreover, like [at the time of starting of a chill term], when exhaust gas temperature is very low, a controller 36 operates electric heaters 84 and 86, and when the 3rd temperature sensor 103 detects that exhaust gas temperature amounted to 300 degrees C, electric heaters 84 and 86 are stopped.
[0021] Although not illustrated as the NOx reduction equipment and the example of a comparison of the 3rd example of the above, except for having the single supply pipe to which it was inserted in from near the upper edge of an upstream exhaust pipe, and the injection nozzle was connected near the down-stream edge of an upstream exhaust pipe through the inside of an upstream exhaust pipe, the NOx reduction equipment of the 3rd example of the above and the NOx reduction equipment of the same configuration were prepared, and the rate of reduction of NOx was investigated. Consequently, as shown in drawing 2 , the rate of NOx reduction improved in the 3rd example. Since it is not such in the 3rd example to comparatively long time amount heating being carried out, burning or oxidizing, and the rate of NOx reduction worsening rapidly by exhaust gas hot within the supply pipe with which a reducing agent passes along the inside of an upstream exhaust pipe by the example of a comparison when especially exhaust gas temperature becomes 400 degrees C or more, the rate of NOx reduction is good.
[0022] In addition, although only a predetermined distance twisted the heating duct around the upstream spirally from the nozzle among upstream exhaust pipes in the 1st example of the above, you may make it the so-called double pipe structure of forming the heating duct 124 of a supply pipe 121 so that only predetermined die length may cover upstream exhaust pipe 13a as shown in drawing 5 . In drawing 5 , the same sign as drawing 1 shows the same components.
Moreover, although the reducing-agent temperature sensor which detects the temperature of the reducing agent before being injected from an injection nozzle was inserted in the down-stream edge of a heating duct in the 1st example of the above, you may insert in an injection nozzle. Moreover, although the temperature sensor was inserted in the upstream exhaust pipe in the 1st example of the above, you may insert in an exhaust manifold.
[0023] moreover -- although three branched pipes were prepared in the 1st and 2nd examples of the above -- two -- or four or more may be prepared. Moreover, although the injection nozzle was mentioned as the injection section in the 1st and 2nd examples of the above, as long as a reducing agent is heated and a pressure fully increases in the injection section, the short pipe which has a heating duct and an abbreviation same bore is sufficient as the injection section. Moreover, although the reducing-agent temperature sensor which detects the temperature of the reducing agent before being injected from an injection nozzle was inserted in the heating duct in the 2nd example of the above, you may insert in an injection nozzle. Moreover, although predetermined spacing was opened in the upstream exhaust pipe and three injection nozzles were inserted in it in the 3rd example of the above, 2 or 4 or more are sufficient.
[0024] Moreover, although any one in the 1st - the 3rd branched pipe was opened in the above 1st - the 3rd example, according to exhaust gas temperature or engine operational status, two or more branched pipes in the 1st - the 3rd branched pipe may be opened. Moreover, an electric heater may be twisted covering the overall length of the upstream exhaust pipe of the 1st and

3rd examples of the above, and an electric heater may be twisted around the upstream exhaust pipe of the 2nd example. Moreover, as long as it can heat the exhaust gas of an upstream exhaust pipe, you may heat using heat carriers, such as a steam instead of an electric heater. Furthermore, although the closing motion valves 41-43 and electric heaters 26, 84, and 86 were controlled by the above 1st - the 4th example based on exhaust gas temperature, since the control temperature is determined by the combination of the class of catalyst, and the class of reducing agent, it is not limited to the numeric value indicated in the above 1st - the 4th example.

[0025]

[Effect of the Invention] As stated above, according to this invention, the end face of the main line of the supply pipe which connects a tank and the injection section is connected to the delivery of a pump. The injection section is connected to the down-stream edge of the heating duct wound around the peripheral face of an upstream exhaust pipe. A end face changes the die length which passes through the heating duct of a reducing agent the tip of two or more branched pipes connected at the tip of a main line, and connects with a heating duct, respectively. Furthermore, since it constituted so that the bulb by which a controller opens and closes two or more branched pipes based on the detection output of a temperature sensor and a reducing-agent temperature sensor might be controlled A controller chooses the branched pipe which passes a reducing agent according to change of the exhaust gas temperature in an upstream exhaust pipe, and changes the distance in which a reducing agent passes through a heating duct. Consequently, since it is maintained at abbreviation regularity and a reducing agent will be in the condition near evaporation or evaporation, it decomposes suitably and the temperature of the reducing agent injected from the injection section becomes high activity more, a reducing agent is supplied to an NOx catalyst at homogeneity, and NOx can be reduced. Therefore, NOx catalyst skin temperature is not reduced like the conventional exhaust gas purge, and the rate of flow of exhaust gas is not increased. Moreover, even if exhaust gas temperature is low temperature comparatively, it will be in the condition certainly near evaporation or evaporation about a reducing agent, and NOx can be reduced certainly.

[0026] Moreover, since a controller changes the distance in which a reducing agent passes the branched pipe in an exhaust manifold by choosing the branched pipe which passes a reducing agent according to change of the reducing-agent temperature in a heating duct even if it inserts a heating duct in an upstream exhaust pipe along with the longitudinal direction of this exhaust pipe, and it inserts two or more branched pipes so that overall lengths may differ in an exhaust manifold, respectively, the same effectiveness as the above is acquired. Furthermore, since the distance in which a controller chooses as the branched pipe which passes a reducing agent according to change of the exhaust gas temperature in an upstream exhaust pipe, and a reducing agent passes an upstream exhaust pipe is changed even if change the distance from an NOx catalyst into an upstream exhaust pipe, it prepares two or more injection sections, it connects the end face of two or more branched pipes of a supply pipe to ******** and it connects two or more injection sections at the tip of these branched pipes further, respectively, the same effectiveness as the above is acquired.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the NOx reduction equipment in the 1st example engine exhaust gas of this invention.
[Drawing 2] The block diagram corresponding to drawing 1 which shows the 2nd example of this invention.
[Drawing 3] The block diagram corresponding to drawing 1 which shows the 3rd example of this invention.
[Drawing 4] Drawing showing change by the exhaust gas temperature in the exhaust-manifold outlet of the rate of NOx reduction by the NOx reduction equipment of the 3rd example of this invention, and the example of a comparison.
[Drawing 5] The sectional view corresponding to drawing 1 which shows the 4th example of this invention.
[Description of Notations]
11 Engine
12 Exhaust Manifold
13 Exhaust Pipe
13a Upstream exhaust pipe
14 NOx Catalyst
17, 67, 81-83 Injection nozzle (injection section)
18 Hydrocarbon System Reducing Agent
19 Tank
21 61,111,121 Supply pipe
22 Pump
23 Main Line
24 64,124 Heating duct
27 Reducing-Agent Temperature Sensor
31-33, 71-73, 91-93 Branched pipe
36 Controller
41-43 Closing motion valve (bulb)
51, 52,101-104 Temperature sensor

[Translation done.]

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(71)出願人　000005463
日野自動車工業株式会社
東京都日野市日野台3丁目1番地1

(72)発明者　茂木　浩伸
東京都日野市日野台3丁目1番地1　日野自動車工業株式会社内

(72)発明者　伴野　靖幸
東京都日野市日野台3丁目1番地1　日野自動車工業株式会社内

(72)発明者　細谷　満
東京都日野市日野台3丁目1番地1　日野自動車工業株式会社内

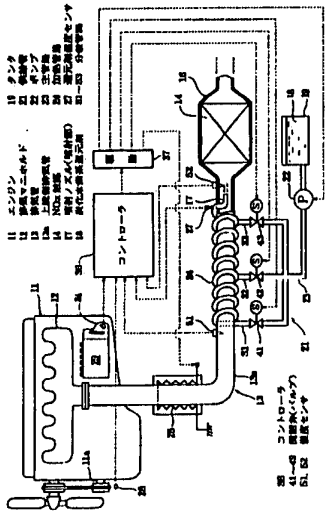
(74)代理人　弁理士　須田　正義

(54)【発明の名称】　エンジン排ガス中のＮＯｘ低減装置

(57)【要約】

【目的】ＮＯｘ触媒表面温度を低下させずかつ排ガスの流速を増大させずに、排ガス温度が低温であっても還元剤を気化して、ＮＯｘを確実に低減する。

【構成】エンジン１１の排気管１３に設けたＮＯｘ触媒１４より排ガス上流側の上流側排気管１３ａに噴射ノズル１７を設け、タンク１９に貯えた還元剤１８をポンプ２２が供給管２１を介して噴射ノズルに圧送する。供給管の主管路２３の基端をポンプの吐出口に接続し、上流側排気管の外周面に巻かれた加熱管路２４の下流端に噴射ノズルを接続する。基端を主管路の先端に接続した複数の分岐管路３１～３３の先端を還元剤の加熱管路を通過する長さを変えてそれぞれ加熱管路に接続する。コントローラ３６が排ガス温度を検出する温度センサ５１，５２及び還元剤の温度を検出する還元剤温度センサ２７の各検出出力に基づいて複数の分岐管をそれぞれ開閉するバルブ４１～４３を制御する。



【特許請求の範囲】

【請求項１】　エンジン(11)に排気マニホルド(12)を介して接続された排気管(13)に設けられたＮＯｘ触媒(14)と、前記ＮＯｘ触媒(14)より排ガス上流側の上流側排気管(13a)に設けられた噴射部(17)と、炭化水素系還元剤(18)を貯えるタンク(19)と、前記タンク(19)に貯えられた還元剤(18)を供給管(21)を介して前記噴射部(17)に圧送するポンプ(22)と、前記供給管(21)に設けられ前記供給管(21)を開閉するバルブ(41～43)とを備えたエンジン排ガス中のＮＯｘ低減装置において、

前記供給管(21)が、

基端が前記ポンプ(22)の吐出口に接続された主管路(23)と、

前記上流側排気管(13a)の外周面に巻かれ下流端に前記噴射部(17)が接続された加熱管路(24)と、

基端が前記主管路(23)の先端に接続され先端が前記還元剤(18)の加熱管路(24)を通過する長さを変えて前記加熱管路(24)にそれぞれ接続された複数の分岐管路(31～33)とを備え、

前記バルブ(41～43)が前記複数の分岐管路(31～33)のうちのいずれか１本又は２本以上の分岐管路(31～33)を開くように構成され、

前記上流側排気管(13a)内又は前記排気マニホルド(12)内の排ガス温度を検出する温度センサ(51,52)が前記上流側排気管(13a)又は前記排気マニホルド(12)に挿入され、

前記噴射部(17)から噴射される前の還元剤(18)の温度を検出する還元剤温度センサ(27)が前記加熱管路(24)又は前記噴射部(17)に挿入され、

前記温度センサ(51,52)及び前記還元剤温度センサ(27)の各検出出力に基づいてコントローラ(36)が前記バルブ(41～43)を制御するように構成されたことを特徴とするエンジン排ガス中のＮＯｘ低減装置。

【請求項２】　エンジン(11)に排気マニホルド(12)を介して接続された排気管(13)に設けられたＮＯｘ触媒(14)と、前記ＮＯｘ触媒(14)より排ガス上流側の上流側排気管(13a)に設けられた噴射部(67)と、炭化水素系還元剤(18)を貯えるタンク(19)と、前記タンク(19)に貯えられた還元剤(18)を供給管(61)を介して前記噴射部(67)に圧送するポンプ(22)と、前記供給管(61)に設けられ前記供給管(61)を開閉するバルブ(41～43)とを備えたエンジン排ガス中のＮＯｘ低減装置において、

前記供給管(61)が、

基端が前記ポンプ(22)の吐出口に接続された主管路(23)と、

前記上流側排気管(13a)にこの排気管(13a)の長手方向に沿って挿入され下流端に前記噴射部(67)が接続された加熱管路(64)と、

基端が前記主管路(23)の先端に接続され先端が前記加熱管路(64)の上流端に接続されかつ前記排気マニホルド(12)に全長がそれぞれ異なるように挿入された複数の分岐管路(71～73)とを備え、

前記バルブ(41～43)が前記複数の分岐管路(71～73)のうちのいずれか１本又は２本以上の分岐管路(71～73)を開くように構成され、

前記噴射部(67)から噴射される前の還元剤(18)の温度を検出する還元剤温度センサ(27)が前記加熱管路(64)又は前記噴射部(67)に挿入され、

前記還元剤温度センサ(27)の検出出力に基づいてコントローラ(36)が前記バルブ(41～43)を制御するように構成されたことを特徴とするエンジン排ガス中のＮＯｘ低減装置。

【請求項３】　エンジン(11)に排気マニホルド(12)を介して接続された排気管(13)に設けられたＮＯｘ触媒(14)と、前記ＮＯｘ触媒(14)より排ガス上流側の上流側排気管(13a)に設けられた噴射ノズル(81～83)と、炭化水素系還元剤(18)を貯えるタンク(19)と、前記タンク(19)に貯えられた還元剤(18)を供給管(111)を介して前記噴射ノズル(81～83)に圧送するポンプ(22)と、前記供給管(111)に設けられ前記供給管(111)を開閉するバルブ(41～43)とを備えたエンジン排ガス中のＮＯｘ低減装置において、

前記噴射ノズル(81～83)が前記上流側排気管(13a)に前記ＮＯｘ触媒(14)からの距離を変えて複数設けられ、

前記供給管(111)が、

基端が前記ポンプ(22)の吐出口に接続された主管路(23)と、

基端が前記主管路(23)に接続され先端に前記複数の噴射ノズル(81～83)がそれぞれ接続された複数の分岐管路(91～93)とを備え、

前記バルブ(41～43)が前記複数の分岐管路(91～93)のうちのいずれか１本又は２本以上の分岐管路(91～93)を開くように構成され、

前記上流側排気管(13a)内又は前記排気マニホルド(12)内の排ガス温度を検出する温度センサ(101～104)が前記上流側排気管(13a)又は前記排気マニホルド(12)に挿入され、

前記温度センサ(101～104)の検出出力に基づいてコントローラ(36)が前記バルブ(41～43)を制御するように構成されたことを特徴とするエンジン排ガス中のＮＯｘ低減装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、エンジンの排ガスに含まれる窒素酸化物（以下、ＮＯｘという）を触媒により低減する装置に関する。更に詳しくは車両用エンジンの排ガス中のＮＯｘ低減装置に関するものである。

【０００２】

【従来の技術】従来、この種のＮＯｘ低減装置として、本出願人はエンジンの排気管の途中にＮＯｘ触媒及び酸

化触媒が収容された触媒コンバータが接続され、触媒コンバータより排ガス上流側の上流側排気管に噴射ノズルが設けられ、炭化水素系還元剤がタンクに貯えられ、上記還元剤をポンプが供給管を介して噴射ノズルに圧送するように構成された排ガス浄化装置を特許出願した（特開平4－276113）。このように構成された排ガス浄化装置では、還元剤が上流側排気管を流れる排ガスに供給され排気管内で気化されて還元性ガスとなり、排ガスとともにNOx触媒及び酸化触媒に供給される。この結果、還元性ガスによりNOx触媒において排ガス中に含まれる高い効率でNOxを低減でき、更に余剰の炭化水素及び上記還元の際に発生する一酸化炭素を酸化触媒にて酸化できるようになっている。

【0003】

【発明が解決しようとする課題】しかし、上記従来の排ガス浄化装置では、常温即ち排ガスに比べて低温の還元剤が噴射ノズルから噴射されてNOx触媒に供給されるため、還元剤が排ガスや触媒表面から気化熱を奪い、触媒表面の温度が低下し、触媒性能が低下する恐れがあった。また上記従来の排ガス浄化装置では、噴射ノズルからは噴射用圧縮エアによりミスト状にして還元剤が噴射されるため、排ガスの流速が増大することにより排ガス及び還元剤の触媒表面への接触率が減少して、触媒性能が低下する場合があった。更に上記従来の排ガス浄化装置では、エンジンの始動時等の排ガス温度が低い場合には、還元剤が気化せずミスト状のまま触媒に供給されてしまい、還元剤を触媒に均一に供給することが難しい問題点があった。

【0004】本発明の目的は、NOx触媒表面温度を低下させずかつ排ガスの流速を増大させずに、排ガス温度が比較的低温であっても還元剤を気化もしくは気化に近い状態にして、NOxを確実に低減できるエンジン排ガス中のNOx低減装置を提供することにある。

【0005】

【課題を解決するための手段】上記目的を達成するための本発明の構成を、実施例に対応する図1～図3を用いて説明する。本発明の第1は、図1に示すようにエンジン11に排気マニホルド12を介して接続された排気管13に設けられたNOx触媒14と、NOx触媒14より排ガス上流側の上流側排気管13aに設けられた噴射部17と、炭化水素系還元剤18を貯えるタンク19と、タンク19に貯えられた還元剤18を供給管21を介して噴射部17に圧送するポンプ22と、供給管21に設けられ供給管21を開閉するバルブ41～43とを備えたエンジン排ガス中のNOx低減装置の改良である。その特徴ある構成は、供給管21が、基端がポンプ22の吐出口に接続された主管路23と、上流側排気管13aの外周面に巻かれ下流端に噴射部17が接続された加熱管路24と、基端が主管路23の先端に接続され先端が還元剤18の加熱管路24を通過する長さを変えて加熱管路24と、基端が主管路23の先端に接続され先端が加熱管路24の上流端に接続されかつ排気マニホルド12に全長がそれぞれ異なるように挿入された複数の分岐管路71～73とを備え、バルブ41～43が複数の分岐管路71～73のうちのいずれか1本又は2本以上の分岐管路71～73を開くように構成され、噴射部67から噴射される前の還元剤18の温度を検出する還元剤温度センサ27が加熱管路64に挿入され、還元剤温度センサ27の検出出力に基づいてコントローラ36がバルブ41～43を制御するように構成されたことを特徴とする。

【0006】本発明の第2は、図2に示すように供給管61が、基端がポンプ22の吐出口に接続された主管路23と、上流側排気管13aにこの排気管13aの長手方向に沿って挿入され下流端に噴射部67が接続された加熱管路64と、基端が主管路23の先端に接続され先端が加熱管路64の上流端に接続されかつ排気マニホルド12に全長がそれぞれ異なるように挿入された複数の分岐管路71～73とを備え、バルブ41～43が複数の分岐管路71～73のうちのいずれか1本又は2本以上の分岐管路71～73を開くように構成され、噴射部67から噴射される前の還元剤18の温度を検出する還元剤温度センサ27が加熱管路64に挿入され、還元剤温度センサ27の検出出力に基づいてコントローラ36がバルブ41～43を制御するように構成されたことを特徴とする。

【0007】本発明の第3は、図3に示すように噴射ノズル81～83が上流側排気管13aにNOx触媒14からの距離を変えて複数設けられ、供給管111が、基端がポンプ22の吐出口に接続された主管路23と、基端が主管路23に接続され先端に複数の噴射ノズル81～83がそれぞれ接続された複数の分岐管路91～93とを備え、バルブ41～43が複数の分岐管路91～93のうちのいずれか1本又は2本以上の分岐管路91～93を開くように構成され、上流側排気管13a又は排気マニホルド12内の排ガス温度を検出する温度センサ101～104が上流側排気管13a又は排気マニホルド12に挿入され、温度センサ101～104の検出出力に基づいてコントローラ36がバルブ41～43を制御するように構成されたことを特徴とする。

【0008】

【作用】図1に示されるNOx低減装置では、コントローラ36は上流側排気管13a内の排ガス温度の変化に応じて還元剤18を通過させる分岐管路31～33を選択することにより、還元剤18が加熱管路24を通過する距離を変える。この結果、噴射部17から噴射される還元剤18の温度が略一定に保たれ、還元剤18は気化もしくは気化に近い状態になって適当に分解し、より高活性になるので、還元剤18がNOx触媒14に均一に供給され、NOxを確実に低減できる。図2に示されるNOx低減装置では、コントローラ36は加熱管路64内の還元剤18の温度の変化に応じて還元剤18を通過させる分岐管路71～73を選択することにより、還元剤18が排気マニホルド12内の分岐管路71～73を通過する距離を変える。図3に示されるNOx低減装置では、コントローラ36は上流側排気管13a内の排ガス温度の変化に応じて還元剤18を通過させる分岐管路91～93を選択することにより、還元剤18が上流側排気管13aを通過する距離を変える。

【0009】

【実施例】次に本発明の第1実施例を図面に基づいて詳しく説明する。図1に示すように、ディーゼルエンジン11には排気マニホルド12を介して排気管13が接続される。この排気管13の途中にはNOx触媒14が収容された触媒コンバータ16が設けられる。この例ではNOx触媒14はモノリス触媒であって、コージェライト性のハニカム単体に銅イオン交換ゼオライト（Cu－ZSM－5）触媒又は銅を担持したメタロシリケート触媒がコーティングされたものである。NOx触媒14より排ガス上流側の上流側排気管13aには炭化水素系還元剤18を噴射可能な噴射ノズル17が触媒コンバータ16近傍にNOx触媒14に向けて設けられる。上記還元剤18はタンク19に貯えられ、供給管21を介してポンプ22によりノズル17に圧送される。還元剤18はこの例では軽油である。

【0010】供給管21は基端がポンプ22の吐出口に接続された主管路23と、上流側排気管13aの外周面に巻かれ下流端にノズル17が接続された加熱管路24と、基端が主管路23の先端に接続され先端が還元剤18の加熱管路24を通過する長さを変えて加熱管路24にそれぞれ接続された複数の分岐管路31～33とを備える。この例では、加熱管路24は上流側排気管13aのうちノズル17より所定の距離だけ上流側に螺旋状に巻付けられ、分岐管路31～33は第1～第3分岐管路31～33の3本設けられる。第1分岐管路31の先端は加熱管路24の上流端に接続され、第2分岐管路32の先端は加熱管路24の略中央に接続され、第3分岐管路33の先端は加熱管路24の下流端近傍に接続される。第1～第3分岐管路31～33にはこれらの分岐管路31～33をそれぞれ開閉する第1～第3開閉弁41～43が設けられ、上流側排気管13aの外周面には排気マニホルド12と加熱管路24との間に位置するように電気ヒータ26が巻付けられる。開閉弁41～43はこの例では分岐管路31～33をそれぞれ開閉する電磁弁であり、オンすると分岐管路31～33をそれぞれ開き、オフすると分岐管路31～33をそれぞれ閉じるようになっている。

【0011】また上流側排気管13aにはこの排気管13a内を流れる排ガスの温度を検出する温度センサ51，52が挿入される。温度センサ51，52はこの例では第1及び第2温度センサ51，52の2本である。第1温度センサ51は加熱管路24より上流側に、第2温度センサ52はノズル17とNOx触媒14との間にそれぞれ挿入される。27は加熱管路24の下流端に挿入された還元剤温度センサであり、このセンサ27によりノズル17から噴射される直前の気化もしくは気化に近い状態になった還元剤18の温度が検出される。またエンジン11のクランク軸11aにはこのクランク軸11aの回転速度を検出する回転センサ28が設けられ、燃料噴射ポンプ29にはコントロールラック（図示せず）の位置を検出する負荷センサ34が設けられる。第1温度センサ51、第2温度センサ52、還元剤温度センサ27、回転センサ28及び負荷センサ34の検出出力はコントローラ36の制御入力に接続され、コントローラ36の制御出力には駆動回路37を介してポンプ22、第1～第3開閉弁41～43及び電気ヒータ26に接続される。またポンプ22の吐出口とタンク19とは図示しないが逆止弁を有する戻り管により接続され、第1～第3開閉弁41～43の全てが閉じたときにポンプ22により吐出された還元剤18をタンク19に戻すようになっている。

【0012】このように構成されたエンジン排ガス中のNOx低減装置の動作を説明する。先ずエンジン11が軽負荷で、かつ低速域の運転状態のときには、エンジン11から排出されて第1温度センサ51により検出される排ガス温度は300℃未満であるため、コントローラ36は第1開閉弁41をオンして第1分岐管路31を開く。ポンプ22により圧送された還元剤18は第1分岐管路31を介して加熱管路24にその上流端から流入し、加熱管路24の下流端に向って流れる。このとき上流側排気管13aの外周面温度が比較的低くても還元剤18が加熱管路24を通過する距離が長く、その加熱時間が長いため、還元剤18は十分に加熱されて気化し易くなる。上流側排気管13aにより加熱されて気化もしくは気化に近い状態になった還元剤18は上記気化に伴う圧力増加により噴射ノズル17からNOx触媒14に向って噴射される。またこのとき還元剤18が加熱管路24内で無酸素状態で強熱されるので、還元剤18が適当に分解し、より高活性になる。この結果、還元剤18によりNOx触媒14表面温度を低下させることがなく、還元剤18がNOx触媒14に均一に供給されるので、NOx触媒14の性能を十分に引出すことができ、NOxを確実に低減できる。

【0013】第1温度センサ51の検出する排ガス温度が300℃以上になり、還元剤温度センサ27が300℃以上の還元剤18温度を検出すると、コントローラ36は第1開閉弁41をオフして第2開閉弁42をオンする。還元剤18が加熱管路24を通過する距離が上記の約半分となり、その加熱時間が短くなるため、還元剤18の温度は300℃未満となり、還元剤18が燃焼した

り或いは酸化したりすることはない。第１温度センサ５１の検出する排ガス温度が更に高くなって４００℃以上になると、コントローラ３６は第２開閉弁４２をオフして第３開閉弁４３をオンする。還元剤１８が加熱管路２４を通過する距離は極めて短いが、上流側排気管１３ａの温度が高いので、還元剤１８は即座に気化する。また寒冷期の始動時のように排ガス温度が極めて低いときには、コントローラ３６は電気ヒータ２６を作動させ、加熱管路２４の下流端での還元剤１８の温度が３００℃に達したことを還元剤温度センサ２７が検出したときに、電気ヒータ２６を停止させる。

【００１４】図２は本発明の第２実施例を示す。図２において図１と同一符号は同一部品を示す。この例では、供給管６１の加熱管路６４が上流側排気管１３ａにこの排気管１３ａの長手方向に沿って挿入され、複数の分岐管路７１～７３が排気マニホルド１２に全長がそれぞれ異なるように挿入される。加熱管路６４の下流端には噴射ノズル６７が接続される。複数の分岐管路７１～７３はこの例では３本であり、排気マニホルド１２の後端から前端に向って第１～第３分岐管路７１～７３が順に所定の間隔をあけて挿入される。これらの分岐管路７１～７３の基端は主管路２３の先端に接続され、分岐管路７１～７３の先端は加熱管路６４の上流端に接続される。第３分岐管路７３の先端は加熱管路６４の上流端を折曲して第３分岐管路７３の先端に対向させた状態で、加熱管路６４の上流端に接続される。第２分岐管路７２の先端は折曲して加熱管路６４の上流端及び第３分岐管路７３の先端の接続部に接続され、第１分岐管路７１の先端は折曲して第２分岐管路７２の折曲部に接続される。排気マニホルド１２内で還元剤１８が通過する各分岐管路７１～７３の長さは第１分岐管路７１を通過する場合が最も長く、次に第２分岐管路７２であり、第３分岐管路７３を通過する場合が最も短くなるように構成される。

【００１５】また第１～第３分岐管路７１～７３のうち排気マニホルド１２から突出する部分にはこれらの分岐管路７１～７３を開閉する第１～第３開閉弁４１～４３がそれぞれ設けられ、加熱管路６４には加熱管路６４内の還元剤１８の温度を検出する還元剤温度センサ２７が挿入される。コントローラ３６は還元剤温度センサ２７、回転センサ２８及び負荷センサ３４の各検出出力に基づいて第１～第３開閉弁４１～４３を制御するように構成される。

【００１６】このように構成されたＮＯｘ低減装置の動作では、コントローラ３６は加熱管路６４内の還元剤１８の温度の変化に応じて還元剤１８を通過させる分岐管路７１～７３を選択することにより、還元剤１８が排気マニホルド１２内の分岐管路７１～７３を通過する距離を変え、還元剤１８が排気マニホルド１２内の分岐管路７１～７３及び上流側排気管１３ａ内の加熱管路６４を通過するときに加熱されることを除いて、上記第１実施例の動作と同様であるので、繰返しの説明を省略する。

【００１７】図３は本発明の第３実施例を示す。図３において図１と同一符号は同一部品を示す。この例では、噴射ノズル８１～８３が上流側排気管１３ａにＮＯｘ触媒１４からの距離を変えて複数設けられ、基端が主管路２３に接続された供給管１１１の複数の分岐管路９１～９３の先端に複数の噴射ノズル８１～８３がそれぞれ接続される。この例では噴射ノズル８１～８３は第１～第３噴射ノズル８１～８３の３本設けられ、分岐管路９１～９３は第１～第３分岐管路９１～９３の３本設けられる。第１噴射ノズル８１は上流側排気管１３ａの上流端近傍に挿入され、第２噴射ノズル８２は上流側排気管１３ａの長手方向の略中央に挿入され、第３噴射ノズル８３は上流側排気管１３ａの下流端近傍に挿入される。第１～第３分岐管路９１～９３の先端は第１～第３噴射ノズル８１～８３にそれぞれ接続される。第１～第３分岐管路９１～９３にはこれらの分岐管路９１～９３を開閉する第１～第３開閉弁４１～４３がそれぞれ設けられる。上流側排気管１３ａのうち第１及び第２噴射ノズル８１，８２間と、第２及び第３噴射ノズル８２，８３間にはそれぞれ電気ヒータ８４，８６が巻付けられる。

【００１８】排気マニホルド１２の下流端にはこの部分を通過する排ガス温度を検出する第１温度センサ１０１が挿入され、上流側排気管１３ａの長手方向の略中央にはこの部分を通過する排ガス温度を検出する第２温度センサ１０２が挿入され、上流側排気管１３ａの下流端にはこの部分を通過する排ガス温度を検出する第３温度センサ１０３が挿入される。またＮＯｘ触媒１４より排ガス下流側の下流側排気管１３ｂにはこの部分を通過する排ガス温度を測定する第４温度センサ１０４が挿入される。第１～第４温度センサ１０１～１０４、回転センサ２８及び負荷センサ３４の各検出出力はコントローラ３６の制御入力に接続され、コントローラ３６の制御出力には駆動回路３７を介して第１～第３開閉弁４１～４３、ポンプ２２及び電気ヒータ８４，８６に接続される。

【００１９】このように構成されたエンジン排ガス中のＮＯｘ低減装置の動作を説明する。先ずエンジン１１が軽負荷で、かつ低速域の運転状態のときには、エンジン１１から排出されて第１温度センサ１０１により検出される排ガス温度は３００℃未満であるため、コントローラ３６は第１開閉弁４１をオンして第１分岐管路９１を開く。ポンプ２２により圧送された還元剤１８は第１分岐管路９１を介して第１噴射ノズル８１から噴射される。この噴射された還元剤１８の温度は低く常温に近いためミスト状であり、また上流側排気管１３ａ内を通過する排ガス温度も比較的低いけれども、還元剤１８が上流側排気管１３ａを通過する距離が長く、その加熱時間が長いため、還元剤１８は十分に加熱されて気化もしくは気化に近い状態になり更に適当に分解して、より高活性になる。この結果、還元剤１８によりＮＯｘ触媒１４表面温度を低下させることがなく、還元剤１８がＮＯｘ触媒１４に均一に供給されるので、ＮＯｘ触媒１４の性能を十分に引出すことができ、ＮＯｘを確実に低減できる。

【００２０】第１温度センサ１０１の検出する排ガス温度が３００℃以上になると、コントローラ３６は第１開閉弁４１をオフして第２開閉弁４２をオンする。還元剤１８が上流側排気管１３ａを通過する距離が上記の略半分となり、その加熱時間が短くなるため、還元剤１８の温度は３００℃未満となり、還元剤１８が燃焼したり或いは酸化したりすることはない。第１温度センサ１０１の検出する排ガス温度が更に高くなって４００℃以上になると、コントローラ３６は第２開閉弁４２をオフして第３開閉弁４３をオンする。還元剤１８が上流側排気管１３ａを通過する距離は極めて短いが、上流側排気管１３ａ内の排ガス温度が高いので、還元剤１８は即座に気化する。また寒冷期の始動時のように排ガス温度が極めて低いときには、コントローラ３６は電気ヒータ８４，８６を作動させ、排ガス温度が３００℃に達したことを第３温度センサ１０３が検出したときに、電気ヒータ８４，８６を停止させる。

【００２１】上記第３実施例のＮＯｘ低減装置と、比較例として図示しないが上流側排気管の上流端近傍から挿入されかつ上流側排気管内を通って上流側排気管の下流端近傍に噴射ノズルが接続された単一の供給管を有することを除いて上記第３実施例のＮＯｘ低減装置と同一構成のＮＯｘ低減装置とを用意して、ＮＯｘの低減率を調べた。この結果、図２に示すように第３実施例ではＮＯｘ低減率が向上した。特に排ガス温度が４００℃以上になると、比較例では還元剤が上流側排気管内を通る供給管内で高温の排ガスにより比較的長い時間加熱されて燃焼或いは酸化されてしまい、ＮＯｘ低減率が急激に悪くなるのに対し、第３実施例ではそのようなことがないため、ＮＯｘ低減率は良い。

【００２２】なお、上記第１実施例では加熱管路を上流側排気管のうちノズルより所定の距離だけ上流側に螺旋状に巻付けたが、図５に示すように供給管１２１の加熱管路１２４を上流側排気管１３ａを所定の長さだけ覆うように設けるいわゆる二重管構造にしてもよい。図５において図１と同一符号は同一部品を示す。また、上記第１実施例では噴射ノズルから噴射される前の還元剤の温度を検出する還元剤温度センサを加熱管路の下流端に挿入したが、噴射ノズルに挿入してもよい。また、上記第１実施例では温度センサを上流側排気管に挿入したが、排気マニホルドに挿入してもよい。

【００２３】また、上記第１及び第２実施例では分岐管路を３本設けたが、２本又は４本以上設けてもよい。また、上記第１及び第２実施例では噴射部として噴射ノズルを挙げたが、還元剤が加熱されて噴射部で十分に圧力が増加すれば、噴射部は加熱管路と略同一内径を有する短管等でもよい。また、上記第２実施例では噴射ノズルから噴射される前の還元剤の温度を検出する還元剤温度センサを加熱管路に挿入したが、噴射ノズルに挿入してもよい。また、上記第３実施例では噴射ノズルを上流側排気管に所定の間隔をあけて３本挿入したが、２本又は４本以上でもよい。

【００２４】また、上記第１～第３実施例では第１～第３分岐管路のうちのいずれか１本を開いたが、排ガス温度やエンジンの運転状態に応じて第１～第３分岐管路のうちの２本以上の分岐管路を開いてもよい。また、上記第１及び第３実施例の上流側排気管の全長にわたって電気ヒータを巻付けてもよく、第２実施例の上流側排気管に電気ヒータを巻付けてもよい。また上流側排気管の排ガスを加熱できれば電気ヒータではなく、蒸気等の熱媒体を用いて加熱してもよい。更に、上記第１～第４実施例では開閉弁４１～４３や電気ヒータ２６，８４，８６を排ガス温度に基づいて制御したが、その制御温度は触媒の種類と還元剤の種類の組合せにより決定されるため、上記第１～第４実施例に記載した数値に限定されるものではない。

【００２５】

【発明の効果】以上述べたように、本発明によれば、タンクと噴射部とを接続する供給管の主管路の基端をポンプの吐出口に接続し、上流側排気管の外周面に巻かれた加熱管路の下流端に噴射部を接続し、基端が主管路の先端に接続された複数の分岐管路の先端を還元剤の加熱管路を通過する長さを変えて加熱管路にそれぞれ接続し、更にコントローラが温度センサ及び還元剤温度センサの検出出力に基づいて複数の分岐管路を開閉するバルブを制御するように構成したので、コントローラは上流側排気管内の排ガス温度の変化に応じて還元剤を通過させる分岐管路を選択し、還元剤が加熱管路を通過する距離を変える。この結果、噴射部から噴射される還元剤の温度は略一定に保たれ、還元剤は気化もしくは気化に近い状態になって適当に分解し、より高活性になるので、還元剤がＮＯｘ触媒に均一に供給され、ＮＯｘを低減できる。従って、従来の排ガス浄化装置のようにＮＯｘ触媒表面温度を低下させることはなく、かつ排ガスの流速を増大させることもない。また排ガス温度が比較的低温であっても還元剤を確実に気化もしくは気化に近い状態になって、ＮＯｘを確実に低減できる。

【００２６】また、加熱管路を上流側排気管にこの排気管の長手方向に沿って挿入し、複数の分岐管路を排気マニホルドに全長がそれぞれ異なるように挿入しても、コントローラは加熱管路内の還元剤温度の変化に応じて還元剤を通過させる分岐管路を選択することにより、還元剤が排気マニホルド内の分岐管路を通過する距離を変えるので、上記と同様の効果が得られる。更に、噴射部を上流側排気管にＮＯｘ触媒からの距離を変えて複数設

け、供給管の複数の分岐管路の基端をが主管路に接続し、更にこれらの分岐管路の先端に複数の噴射部をそれぞれ接続しても、コントローラは上流側排気管内の排ガス温度の変化に応じて還元剤を通過させる分岐管路を選択し、還元剤が上流側排気管を通過する距離を変えるので、上記と同様の効果が得られる。

【図面の簡単な説明】

【図１】本発明第１実施例エンジン排ガス中のＮＯｘ低減装置を示す構成図。

【図２】本発明の第２実施例を示す図１に対応する構成図。

【図３】本発明の第３実施例を示す図１に対応する構成図。

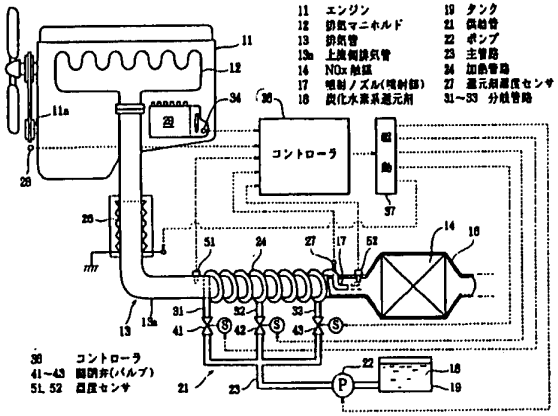
【図４】本発明の第３実施例と比較例のＮＯｘ低減装置によるＮＯｘ低減率の排気マニホルド出口における排ガス温度による変化を示す図。

【図５】本発明の第４実施例を示す図１に対応する断面図。

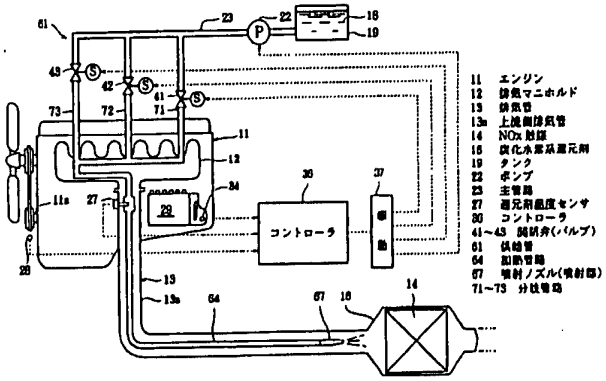
【符号の説明】

１１　エンジン
１２　排気マニホルド
１３　排気管
１３ａ　上流側排気管
１４　ＮＯｘ触媒
１７，６７，８１～８３　噴射ノズル（噴射部）
１８　炭化水素系還元剤
１９　タンク
２１，６１，１１１，１２１　供給管
２２　ポンプ
２３　主管路
２４，６４，１２４　加熱管路
２７　還元剤温度センサ
３１～３３，７１～７３，９１～９３　分岐管路
３６　コントローラ
４１～４３　開閉弁（バルブ）
５１，５２，１０１～１０４　温度センサ

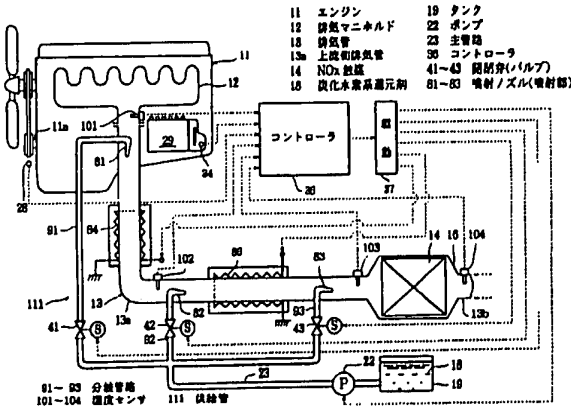
【図１】



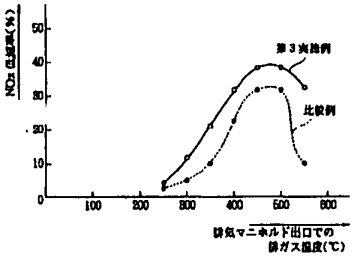
【図２】



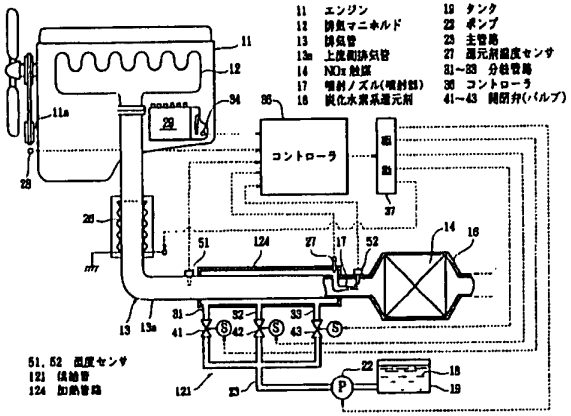
【図３】



【図4】


NOx 低減率(%)
50
40
30
20
10
0
100
200
300
400
500
600
第3実施例
比較例
排気マニホルド出口での
排ガス温度(℃)

【図5】


11　エンジン
12　排気マニホルド
13　排気管
13a　上流側排気管
14　NOx 触媒
17　噴射ノズル(噴射弁)
18　炭化水素系還元剤
19　タンク
22　ポンプ
25　主管路
27　還元剤温度センサ
31～33　分岐管路
35　コントローラ
41～43　開閉弁(バルブ)
コントローラ
51, 52　温度センサ
121　供給管
124　加熱管路